Impact of intravesical prostatic protrusion and pathological type on transurethral resection of the prostate for benign prostatic hyperplasia.

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Abstract

Objective: To investigate the impact of intravesical prostatic protrusion and pathological type on TURP for benign prostatic hyperplasia (BPH).

Methods: Totally 158 cases with BPH were enrolled, then divided into the IPP significant group (n=70) and IPP non-significant group (n=88) according to the degree of intravesical prostatic protrusion (IPP), and patients were also divided into the glandular group (n=46), adenomyoma group (n=32), fibroadenoma group (n=58), fibrovascular group (n=22) according to the results of pathological features. The total prostate volume (TPV), the changes of international prostate symptom score (IPSS), maximum urinary flow rate (ΔQmax) and post-voiding residual urine volume output (ΔPVR), the operation time and intraoperative blood loss of IPP significant group and IPP non-significant group were compared before operation and 6 months after operation. The TPV, operation time, intraoperative blood loss, microvessel density (MVD), prostate specific antigen (PSA), ΔIPSS, ΔQmax and ΔPVR were compared between different pathological type of BPH, and analyzed the correlation among these parameters.

Results: The operation time and IPSS score of IPP significant group were significantly higher than that of IPP non-significant group (P<0.05). The operation time and intraoperative blood loss of glandular group and fibrovascular group were higher than those of adenomyoma group and fibroadenoma group (P<0.05). MVD of fibrovascular group were significantly higher than those of other three groups, and MVD in glandular group and adenomyoma group were significantly higher than those in fibroadenoma group (P<0.05), and difference of the PSA level among the four groups was statistical (P<0.05). The IPP were correlated with operation time and ΔIPSS score (P<0.05). The MVD and PSA were correlated with operation time (P<0.05) and intraoperative blood loss (P<0.05).

Conclusion: The IPP has correlation with operation time and intraoperative blood loss, the conbined evaluation of IPP and pathological type can predict the difficulty and efficacy of TURP, which has application value.

Keywords: Benign prostatic hyperplasia, Intravesical prostatic protrusion, Pathological type, Transurethral resection of prostate.

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Introduction

Benign prostatic hyperplasia (BPH) is one of the common diseases in middle-aged and elderly men [1]. With the acceleration of aging process, the incidence of BPH is increasing year by year. According to other reports, the incidence of BPH of men over 60 years old can be as high as 50%, meanwhile that of the population over 80 years old can be up to 83% [2]. BPH always occurs in the prostate transitional zone, as the urethra is constricted, thereby bladder outlet obstruction (BOO) is caused. Studies [3] pointed out if the BOO in patients with BPH could not be released early, it may lead to acute urinary retention and other complications, which increase the risk of urinary tract infections. Although the urodynamic test is the effective standard for the diagnosis of BOO [4], which is complicated and difficult for some patients to accept, therefore it cannot be totally popularized. So

observing the size of BPH and the severity of urinary tract obstruction is still used to evaluate the postoperative curative effect preliminarily [5].

However, it was reported that [6] there was 10% to 20% patients with poorly improvements or even further deterioration of postoperative symptoms. Therefore, it is worthy of carrying out to make the precise judgment of BPH in further investigation, and select the appropriate time and method of operation for predicting the operation efficacy. In recent years, some experts have proposed that intravesical prostatic protrusion (IPP), the pathological types of BPH and relevant biochemical indexes have a certain effect on the transurethral resection of prostate (TURP) [7], but there was not enough evidences to reveal the correlations. Currently, it is only reported by Daoyu [8] and Mushi et al. [9]. Therefore, clinical data of 158 patients with BPH in our hospital were

analyzed in this study, to explore the influence of the degree of IPP and pathological types on the TURP.

General Data and Methods

General data

Clinical data of 158 patients with BPH from September 2015 to December 2016 in Hunan Provincial People's Hospital were enrolled. Inclusion criteria: (1) Patients were diagnosed as BPH, with symptoms of recurrent hematuria, urinary retention, urinary tract infection (UTI) or secondary upper urinary tract, etc.; (2) Patients were invalid for conservative treatment. Exclusion criteria: (1) Patients with incompletely relevant clinical data; (2) Patients who had previous prostate operations such as laser and TURP, etc.; (3) Patients with combined severe urethral stricture, neurogenic bladder, prostatic cancer and other severe comorbidities; (4) patients who lost follow-up in 6 months after operation.

Methods

According to the degree of IPP, patients were divided into IPP significant group (IPP ≥ 10 mm, n=70) and IPP non-significant group (IPP<10 mm, n=88). Measurement method of IPP: the patients had drunk appropriate amount of water to fill the bladder to 150~250 ml at 30 min before the examination, and were carried out with transabdominal ultrasonography (TAUS). IPP was defined as the vertical distance of the prostate from the top of the gland protrude to the basal part of the bladder. The 158 patients were divided into the glandular group (glandular hyperplasia type, n=46), adenomyoma group (adenomyoma hyperplasia type, n=32), fibroadenoma group (fibroadenoma hyperplasia type, n=58) and fibrovascular group (fibrovascular hyperplasia type, n=22) according to the results of pathological examination. The standards of pathological classification were similar with the study reported by Liu [10], pathological types of prostate were divided into glandular hyperplasia, adenomyoma hyperplasia, fibroadenoma hyperplasia and fibrovascular hyperplasia type according to glandular cell, fibrocyte, mesenchyme and blood vessel.

Observational parameters

The preoperative data, relevant intraoperative data and follow-up data in six months after operation were compared between the IPP significant group and IPP non-significant group. The preoperative data including total prostate volume (TPV), international prostate symptom score (IPSS), maximum urinary flow rate (Qmax) and post-voiding residual urine volume (PVR); the relevant intraoperative data including operation time and intraoperative blood loss; follow-up data including the IPSS, Qmax and PVR in 6 months after operation.

Evaluation methods are as follows [11]: diameter and left-right diameter of the prostate measured by the preoperative ultrasound; PVR refers to the post-voiding residual urine volume measured again by ultrasound after urination; determination method of intraoperative blood loss: mixed with rinse solution evenly, from which 5 ml solution was taken to determine the hemoglobin concentration with the cyanmethemoglobin determination method, the formula: blood loss (ml)=hemoglobin concentration in irrigating solution (g/L) × irrigating solution volume (L)/preoperative hemoglobin concentration. The differences (Δ) of IPSS, Qmax and PVR between the two groups in 6 months before and after the operation was calculated.

The clinical data including TPV, operation time, intraoperative blood loss, prostate specific antigen (PSA), and microvessel density (MVD) of patients with different pathological types were compared. MVD: the pathological specimens resected during the operation were placed under the low-power lens where the slide was scanned to find out the most densely distributed area of microvessels, then the number of microvessels of three fields in the area was calculated under the high power lens, where the average should be taken. The ΔIPSS, ΔQmax and ΔPVR of two groups in 6 months before and after the operation was compared. The correlation analysis: the correlation between the operation time, intraoperative blood loss, ΔIPSS, ΔQmax and ΔPVR, and IPP, MVD, PSA with pathological types of hyperplasia were analyzed by Spearman or Pearson.

Statistical methods

The data were analyzed by SPSS19.0 software, the measurement data were expressed as mean ± standard deviation ($\bar{x}$ ± SD), and the one-way ANOVA was used to make comparisons among groups, the comparisons of two groups were used to the LSD-t. The correlation was analyzed by Spearman or Pearson's test, while P<0.05 was considered that the difference was significant.

Results

The comparisons of clinical data of IPP significant group and IPP non-significant group

There were no significant differences in the intraoperative blood loss, ΔQmax and ΔPVR between the two groups (P>0.05). The operation time of the IPP significant group was significantly longer than that of the IPP non-significant group (P<0.05), and the ΔIPSS score of it was significantly higher than that of the IPP non-significant group (P<0.05). The results are shown in Table 1.

Table 1. *Comparisons of preoperative data and intraoperative data of IPP significant group and IPP non-significant group ($\bar{x}$ ± SD).*

Group	TPV	Operation Time	Intraoperative Blood Loss (ml)	ΔIPSS Scores	ΔQmax (ml/s)	ΔPVR

	(ml)	(min)				(ml)
IPP significant group (70)	56.49 ± 9.29	80.19 ± 11.05	288.04 ± 53.46	11.11 ± 2.92	6.67 ± 1.79	58.27 ± 9.14
IPP non-significant group (88)	56.39 ± 9.70	74.44 ± 10.36	285.10 ± 60.12	8.48 ± 2.99	6.73 ± 1.81	60.42 ± 8.78
t	0.065	3.361	0.321	5.570	0.194	1.501
P	0.948	0.001	0.749	0.000	0.847	0.135

The comparisons of different pathological types in clinical data among groups

There was no significant difference in TPV, ΔIPSS score, ΔQmax and ΔPVR among different pathological types (P>0.05). The operation time and intraoperative blood loss were significantly higher in glandular group and fibrovascular group than those in adenomyoma group and fibroadenoma group (P<0.05). The MVD of the fibrovascular group were significantly higher than those of the other three groups, and the MVD of the glandular group and the adenomyoma group were significantly higher than those of the fibroadenoma group (P<0.05). The PSA of the fibrovascular group were significantly higher than those of the other three groups, and the PSA of the glandular group and the adenomyoma group were significantly lower than those of the fibroadenoma group (P<0.05). The results are shown in Table 2.

Table 2. Comparisons of clinical data among groups of different pathological types ($\bar{x}$ ± SD).

Group	TPV (ml)	Operation Time (min)	Intraoperative Blood Loss (ml)	ΔIPSS Score	ΔQmax (ml/s)	ΔPVR (ml)	MVD (Pcs)	PSA (ng/mL)
Glandular group (46)	55.02 ± 8.89	84.98 ± 9.21[#Δ]	318.80 ± 48.84[#Δ]	9.26 ± 3.04	6.52 ± 1.74	57.37 ± 10.08	23.48 ± 4.84[Δ]	7.30 ± 2.23[Δ]
Adenomyoma group (32)	58.97 ± 9.50	73.22 ± 7.37[*]	237.94 ± 37.41[*]	10.41 ± 3.64	7.13 ± 1.66	60.47 ± 7.48	23.94 ± 2.40[Δ]	9.34 ± 2.39[Δ]
Fibroadenoma group (58)	55.71 ± 9.99	70.55 ± 8.96[*]	266.24 ± 43.14[*]	9.52 ± 2.58	6.83 ± 1.71	60.74 ± 12.83	12.83 ± 3.74[*#]	11.84 ± 3.06[*#]
Fibrovascular group (22)	57.59 ± 9.12	82.73 ± 9.34[#Δ]	342.32 ± 43.27[#Δ]	9.68 ± 4.37	6.14 ± 2.21	59.05 ± 8.88	32.09 ± 5.47[*#Δ]	13.25 ± 2.66[*#Δ]
F	1.331	26.717	37.410	0.840	1.590	1.386	137.835	36.547
P	0.266	0.000	0.000	0.474	0.194	0.249	0.000	0.000

Notes: [*]compared with the glandular group, P<0.05; [#]compared with the adenomyoma group, P<0.05; [Δ]compared with the fibroadenoma group, P<0.05.

The correlation of surgical characteristics and effective parameters with IPP, MVD and PSA

There were significant correlation between IPP and operation time and ΔIPSS score (P<0.05). MVD and PSA were correlated with the operation time and intraoperative blood loss (P<0.05). The results are shown in Table 3.

Table 3. The correlation of surgical characteristics and effective parameters with IPP, MVD and PSA.

Factors	Operation Time		Intraoperative Blood Loss		ΔIPSS Score		ΔQmax		ΔPVR	
	r_s	P	r_s	P	r_s	P	r_s	P	r_s	P
IPP	0.291	0.000	0.111	0.166	0.325	0.000	0.019	0.811	0.127	0.113
MVD	0.383	0.000	0.297	0.000	0.017	0.834	0.034	0.675	0.080	0.320
PSA	0.345	0.000	0.253	0.001	0.116	0.145	0.019	0.811	0.062	0.440

Discussion

In recent 30 years, TURP was thought to be the "golden standard" for the surgical treatment of BPH [12]. It can remove the prostatic hyperplasic tissue, remit the mechanical obstruction, and has prominent curative effect, with the advantages of small trauma and quick recovery. It is noteworthy that massive bleeding, urinary incontinence and other complications are easily to occur during the operation. Besides, the hypotonic irrigation solution was absorbed into the blood circulation, especially in long duration of operation, which will lead to life-threatening complications: transurethral

resection syndrome (TURS) [13]. Thus, much attention must be paid to long operation time and intraoperative massive bleeding.

In this study, the clinical data of 158 cases with BPH was analyzed. It was found that IPP have certain influence on the operation difficulty and curative effect of BPH, which manifested as following: the ∆IPSS of the IPP significant group was significantly higher than that of the IPP non-significant group. The operation time of the IPP significant group was longer than that of the IPP non-significant group. The IPP is a special anatomic structure of BPH, the bladder neck and the capsule of prostate is continuous, the prostate capsule and bladder neck being constricted when the BPH aggravating. But the sensitivity of different tissues to the stimulation of dihydrotestosterone is different, the hyperplastic progression was not synchronized, resulting in part of the prostatic tissue near the bladder neck protruding into the bladder cavity [14,15]. The tissue of the prostate protruding into the bladder can lead to obstruction, which was similar to "valvular barrier" [16]. Some viewpoints argued that [17,18] the length of the IPP into the bladder is correlated with the degree of urinary retention of patients, the longer of the IPP was always along with the higher of the PVR. Perhaps, while the higher of the IPP in BPH patients, thickness of the bladder wall was less obviously. During operation, the more of resected tissue of the stimulation of the bladder neck and vesical triangle, the symptoms such as urinary frequency and urinary urgency will reduced obviously, so the IPSS was significantly improved. Some studies have suggested that [19,20] severe IPP can lead to the bladder outlet stenosis and deform the urethral orifice. In order to antagonize the stenosis of the urethra, the contractility of the detrusor of bladder needs to be strengthened, which will have an adverse stimulation on the valvular effect and the thickness of the bladder wall, causing the thickening of the extracellular collagen, resulting in difficulty in identifying urethral orifice and hemostasis during TURP [21]. This may be the main reason why IPP's size was closely correlated with the operation time and the difficulty of operation. Therefore, the IPP can not only assess the degree of BOO in patients with BPH, but also can be used to evaluate the difficulty and efficacy of TURP operation. In this study, the results also indicated that PSA has a certain correlation with the operation time and intraoperative blood loss. PSA is a kind of serine proteases secreted by epithelial cell of the prostate, which is a kind of specific protein. The normal range of PSA is (4~10 ng/mL), but the PSA of BPH, prostatic cancer and prostatitis can be in this normal range, or may be a little higher than this level, and so many physiological and pathological factors can influence the changes of PSA level. Thus, it has some limitations on its clinical application value.

Intraoperative bleeding is one of the common complications of TURP, which will obscure the vision and increase difficulty in operation [22]. Previous studies have shown that [23,24] the intraoperative blood loss in TURP operation is related to factors such as the capsule perforation, incomplete hemostasis, angiogenesis of microvessels and so on. MVD is an important indicator of angiogenesis, there was studies showing that [25]

finasteride and terazosin have certain influence to reduce hyperplastic prostatic microvessel density, and the intraoperative bleeding can be significantly reduced. The results of this study showed that there was a large difference at the MVD in different pathologic types, and fibrovascular hyperplasia were the highest, followed by those of patients with glandular hyperplasia and adenomyoma hyperplasia, while those of the patients with fibroadenoma hyperplasia were the lowest. In this study, the results of different pathological types also showed that the operative time and intraoperative blood loss of the glandular group and fibrovascular group were higher than those of the adenomyoma group and fibroadenoma group. The correlation analysis suggested that MVD was associated with intraoperative blood loss. It can be found by combining the relevant data that the angiogenesis of microvessels is an important pathological basis that caused intraoperative bleeding and increased surgical difficulty, and the expression intensity of MVD has certain impact on the operation process. Previous studies have shown that [26] intraoperative blood loss is not obviously associated with prostate volume, which is consistent with the findings of this study. As the pathological types belongs to unordered variable data, we cannot make further correlation analysis in statistics. Once there are differences between the different pathological types and the intraoperative blood loss, the pathological types are thought to have correlation with the BPH.

In summary, the IPP and pathological types of BPH were correlated to the efficacy and difficulty of the operation. The greater the IPP is, the longer the operation time is, the more significant improvement in symptoms of patients are. The pathological type is also correlated with intraoperative blood loss and operation time. With the raising of MVD, the density of microvessel will increase, and the blood loss and operation time are extended. Thus, the evaluations of IPP and the pathological types of BPH have a certain referential value for the operative difficulty and postoperative rehabilitation in BPH patients. Due to small sample in this study, the conclusion needs to be confirmed in RCTs with large sample.

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